NASA
Spaceport Engineering and Technology Directorate
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SUBJECT: Failure Analysis of a Windlock Jackscrew

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1.0 ABSTRACT

A windlock jackscrew was submitted for failure analysis after it failed during operation. The jackscrew failed as a result of a combination of torsional and tensile overload.

2.0 FOREWORD

A windlock jackscrew was submitted for failure analysis after it failed during operation.

3.0 PROCEDURES AND RESULTS

3.1 The failed jackscrew was photographed as-received (Figure 1). Figure 2 is a higher magnification view of the fracture surface showing the direction of the failure.

3.2 The fracture surface was cleaned in preparation for analysis by scanning electron microscope (SEM). SEM analysis determined that the fracture surface displayed primarily ductile features with localized regions of transgranular cleavage (Figures 3 and 4). The directionality of the dimples formed by microvoid coalescence (MVC) indicated that the jackscrew failed in torsional overload while under tensile stress. A laboratory-induced overload exemplar displayed equiaxed dimples formed by MVC, indicative of ductile tensile overload (Figure 5).

3.3 The fracture surface was sectioned longitudinally and prepared for metallographic analysis. No crack branching was observed, further indicating that the jackscrew failed in a ductile manner. The microstructure consisted of banded ferrite and pearlite with manganese sulfide stringers (Figures 6 and 7).

3.4 Converted microhardness measurements taken on the longitudinal cross section averaged 30 Rockwell C scale, corresponding to an approximate tensile strength of 136 ksi.

3.5 A section of the jackscrew was submitted to YA-F4-C for chemical analysis. Analysis by inductively coupled argon plasma and combustion methods determined that the jackscrew was composed of AISI 1000 series carbon steel.

4.0 CONCLUSION

The jackscrew failed as a result of a combination of torsional and tensile overload.

EQUIPMENT: SEM, S/N MP1770061
Metallograph, S/N 237386
Microhardness tester, S/N B-D58073

RELATED DOCUMENTATION: KSC-MSL-0527-01-01

CONTRIBUTORS: S. McDanels/YA-F1-M1
D. Jackson/YA-F4-C

PRIMARY INVESTIGATOR: _____
V. J. Cummings/YA-F1-M1

Figure 1

Failed jackscrew, as-received. Arrow indicates fracture surface.

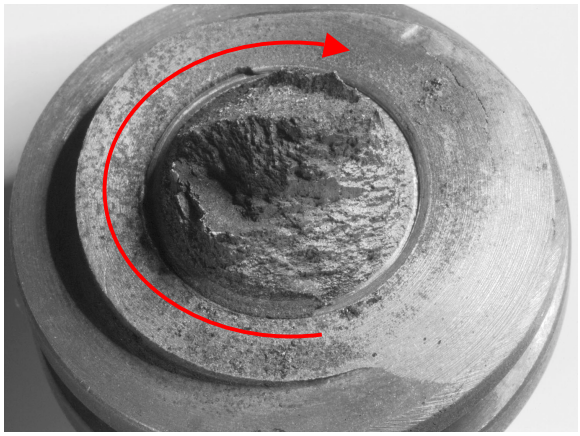

Figure 2

Jackscrew fracture surface. Arrow indicates direction of fracture propagation.
Magnification: 2X

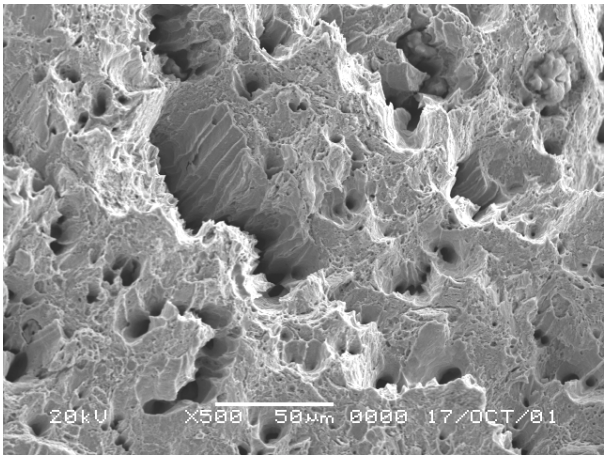

Figure 3

SEM micrograph showing dimples formed by MVC. Magnification: 500X

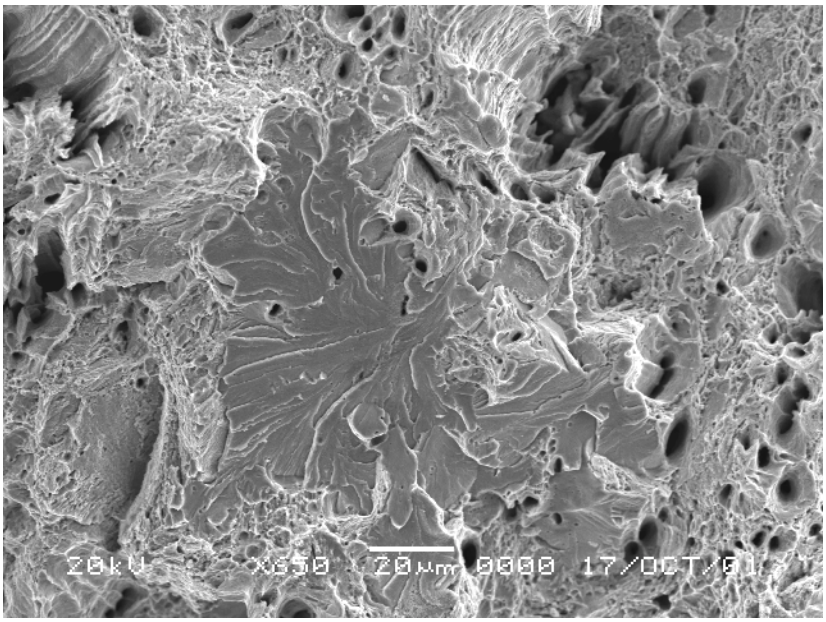

Figure 4

SEM micrograph showing a localized region of transgranular cleavage, surrounded by dimples formed by MVC. Magnification: 650X

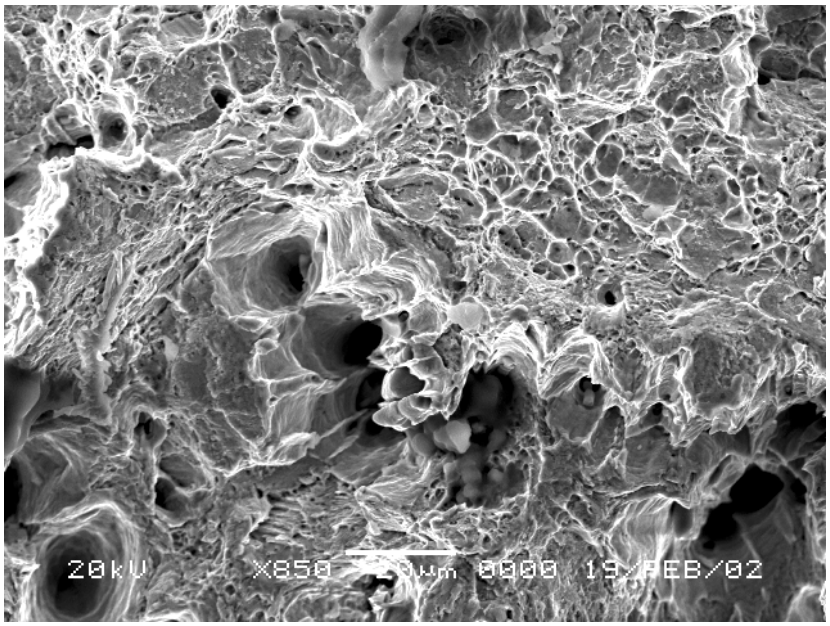

Figure 5

SEM micrograph of laboratory-induced overload exemplar, showing equiaxed dimples formed by MVC. Magnification: 850X

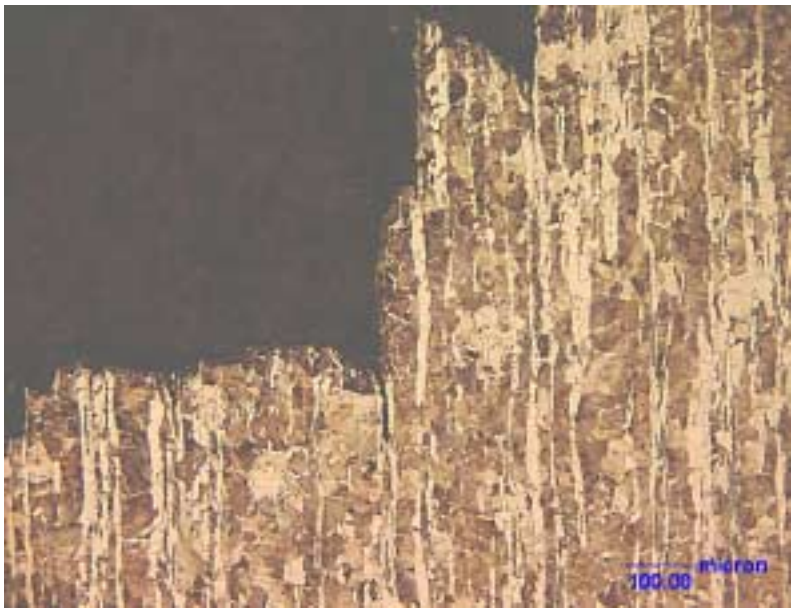

Figure 6

Micrograph showing a longitudinal cross section of the fracture surface (top). The microstructure is banded ferrite (light) and pearlite (dark). Etchant: 2% nital Magnification: 100X

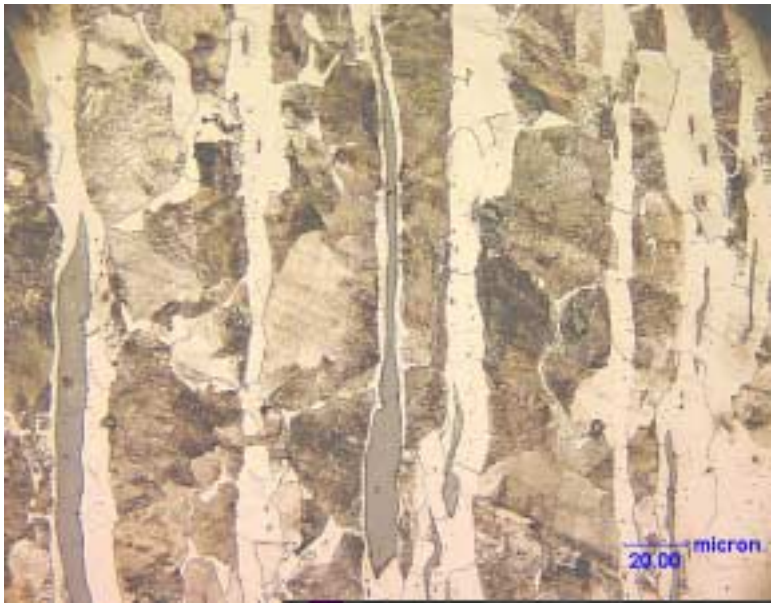

Figure 7

Micrograph showing the bulk microstructure of the longitudinal cross section. The gray feature in the center of the image is a manganese sulfide stringer. Etchant: 2% nital. Magnification: 500X